Center Innovation Fund: MSFC CIF

Piezoelectric Strainmeter for the Seismic Investigation of Planets

Completed Technology Project (2017 - 2018)

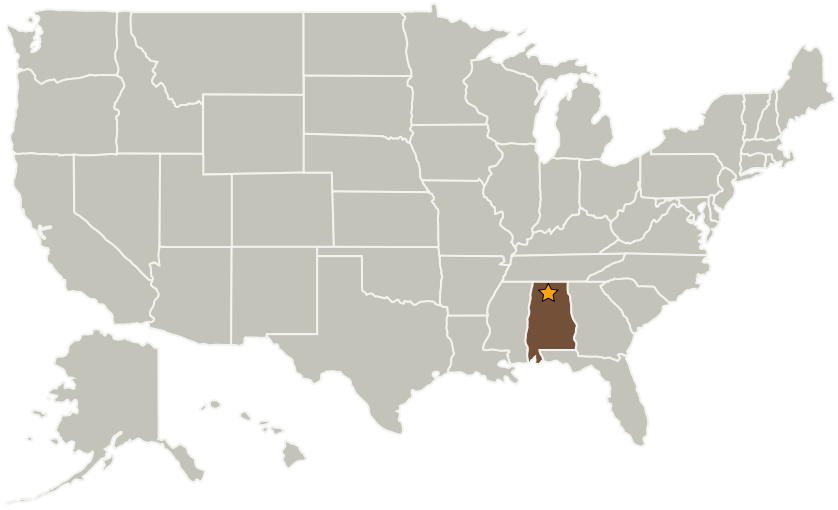
Project Introduction

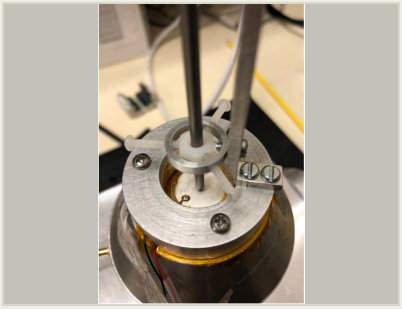
MSFC is currently pursuing the development of piezoelectric crystal oscillator strain and vibration sensors for use in structural integrity testing and monitoring. We propose to adapt these technologies to seismic frequencies of interest (~0.1 - 50 Hz). Piezoelectric sensors are not currently considered mainstream in terrestrial seismology. However, they may port well to planetary implementations where small size, low power, robustness, and high sensitivity are desirable. The current sensor prototypes use a crystal oscillator as the sensing element, measuring mechanical strain as a change in crystal impedance. We use additive manufacturing to develop a compliant structure to convert crystal impedance into an applied load on the crystal oscillator material, based on its mechanical properties.

Anticipated Benefits

Piezoelectric technology is not currently considered mainstream in terrestrial seismology. However, it may port well to planetary implementations where small size, low power, robustness, and high sensitivity are desirable. Commercial lunar landers in the immediate future will favor small, robust payloads that do not require the sophisticated operation procedures and deployment mechanisms currently required by state-of-the-art planetary seismometers.

Primary U.S. Work Locations and Key Partners





Piezo sensor mounted in test assembly.

Table of Contents

Center Innovation Fund: MSFC CIF

Piezoelectric Strainmeter for the Seismic Investigation of Planets

Completed Technology Project (2017 - 2018)

Organizations Performing Work	Role	Type	Location
★Marshall Space Flight Center(MSFC)	Lead Organization	NASA Center	Huntsville, Alabama

Co-Funding Partners	Type	Location
NASA Postdoctoral Fellowship Program	NASA Other	

Primary U.S. Work Locations
Alabama

Project Transitions

October 2017: Project Start

September 2018: Closed out

Closeout Summary: The planetary seismology community has spent the last 20 years heavily advancing the development of very-broadband (VBB) seismic instruments. VBBs maximize scientific return in instances where only small numbers of instruments are able to be deployed, such as for the upcoming InSight mission to Mars. However, they are much heavier and more technologically complex than the instrumentation that is typically used in terrestrial field surveys. Consequently, new development efforts are exploring alternative technologies, including micro-electromechanical systems, fluid seismometers, opto-mechanical geophones, and strainmeters.This project sought to leverage existing MSFC capabilities in the development of a piezoelectric seismometer instrument concept for planetary exploration

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Marshall Space Flight Center (MSFC)

Responsible Program:

Center Innovation Fund: MSFC CIF

Project Management

Program Director:

Michael R Lapointe

Program Manager:

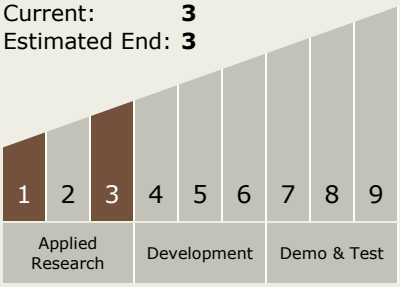
John W Dankanich

Principal Investigator:

Renee C Weber

Technology Maturity (TRL)

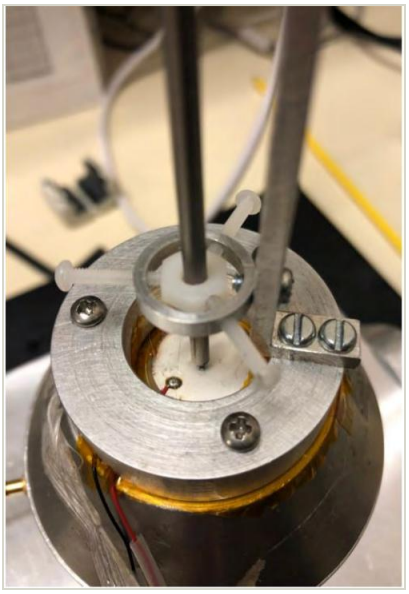
Start: **1**
Current: **3**
Estimated End: **3**



Piezoelectric Strainmeter for the Seismic Investigation of Planets

Completed Technology Project (2017 - 2018)

Images



Project Image
Piezo sensor mounted in test assembly.
(https://techport.nasa.gov/image/35809)

Project Website:

https://www.nasa.gov/directorates/spacetech/innovation_fund/index.html#.VC

Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - TX12.3 Mechanical Systems
    - TX12.3.2 Electro-Mechanical, Mechanical, and Micromechanisms

Target Destinations

Mars, Others Inside the Solar System